

## WHAT IS CLAIMED IS:

1. A dissolvable, strip for whitening teeth in an oral cavity, comprising:  
  
a whitening agent; and  
  
a water-soluble or water dispersible polymer system having a poly(vinylpyrrolidone) or any derivative thereof or any of its copolymers, and at least one other polymer, wherein said strip will dissolve by saliva in an oral environment.
2. The whitening strip of claim 1, wherein said whitening agent is selected from the group consisting of hydrogen peroxide, carbamide peroxide, peroxy carbamate, calcium peroxide, a persulfate salt, a percarbonate salt, perboric acid, perborate salt, PVP-hydrogen peroxide complex, metal chlorite, hydroperoxide, peroxyacids, organic peroxides, peroxide generating compounds, persulfates, chlorine dioxide, hydrogen peroxide adduct of carbodiimide persulfate, and any combinations thereof.
3. The whitening strip of claim 2, wherein said metal chlorite is selected from the group consisting of calcium chlorite, barium chlorite, magnesium chlorite, lithium chlorite, sodium chlorite, potassium chlorite, and any combinations thereof.
4. The whitening strip of claim 1, wherein said whitening agent is about 2 wt% to about 75 wt% of the total weight of the whitening composition.
5. The whitening strip of claim 1, wherein said whitening agent is encapsulated in a water-soluble or water dispersible shell.

6. The whitening strip of claim 5, wherein said water-soluble or water dispersible shell controls the dissolution of said whitening composition by interaction of the shell with saliva.

7. The whitening strip of claim 1, wherein said water-soluble or water dispersible polymer system is selected from the group consisting of a poly(vinylpyrrolidone)-alkyl vinyl ether/maleic anhydride copolymer, poly(vinylpyrrolidone)-alkyl vinyl ether/maleic acid copolymer, poly(vinylpyrrolidone)-alkali metal or an amine salt of alkyl vinyl ether/maleic acid copolymer, poly(vinylpyrrolidone)-partially or fully crosslinked alkyl vinyl ether/maleic anhydride copolymer, poly(vinylpyrrolidone)-vinyl acetate copolymer, poly(vinylpyrrolidone)-polyurethane interpolymer, poly(vinylpyrrolidone)-chitosan, poly(vinylpyrrolidone)-poly(acrylic acid), poly(vinylpyrrolidone)-poly(vinyl alcohol), poly(vinylpyrrolidone)-poly(vinyl alcohol-g-ethylene glycol) copolymer, poly(vinylpyrrolidone)-cellulose derivatives, poly(vinylpyrrolidone)-hydroxy-propyl-methyl cellulose, poly(vinylpyrrolidone)-hydroxy-ethyl cellulose, poly(vinylpyrrolidone)-hydroxy-propyl cellulose, poly(vinylpyrrolidone)-poly(ethylene oxide), poly(vinylpyrrolidone)-poly(propylene oxide), poly(vinylpyrrolidone)-Polyquaterium-11, poly(vinylpyrrolidone)-Polyquaterium-39, poly(vinylpyrrolidone)-poloxamer, poly(vinylpyrrolidone)-carbomer, poly(vinylpyrrolidone)-gelatin, poly(vinylpyrrolidone)-starch, poly(vinylpyrrolidone)-alginic acid, poly(vinylpyrrolidone)-salt of alginic acid, poly(vinylpyrrolidone)-gum karaya, poly(vinylpyrrolidone)-xanthan gum, poly(vinylpyrrolidone)-guar gum, poly(vinylpyrrolidone)-arabic gum, poly(vinylpyrrolidone)-tragacanth, poly(vinylpyrrolidone)-polyvinylpyrrolidone derivatives or copolymers, and any combinations thereof.

8. The whitening strip of claim 7, wherein said poly(vinylpyrrolidone)-polyurethane interpolymer is a poly(vinylpyrrolidone)/polycarbamyl polyglycol ester interpolymer.

9. The whitening strip of claim 1, wherein said at least one other water-soluble or water dispersible polymer is selected from the group consisting of an alkyl vinyl ether/maleic anhydride copolymer, alkyl vinyl ether/maleic acid copolymer, alkali metal or an amine salt of alkyl vinyl ether/maleic acid copolymer, partially or fully crosslinked alkyl vinyl ether/maleic anhydride copolymer, vinyl acetate copolymer, polyacrylates, polyurethane interpolymers, chitosan, poly(acrylic acid), poly(vinyl alcohol), poly(vinyl alcohol-g-ethylene glycol) copolymer, cellulose derivatives, hydroxypropylmethyl cellulose, hydroxyl-ethyl cellulose, hydroxypropyl cellulose, poly(ethylene oxide) or copolymers thereof, poly(propylene oxide) or copolymers thereof, Polyquaterium-11, Polyquaterium-39, poloxamer, carbomer, gelatin, starch, alginic acid, salt of alginic acid, gum karaya, xanthan gum, guar gum, arabic gum tragacanth, and any combinations thereof.

10. The whitening strip of claim 1, wherein said water-soluble or water dispersible polymer system is present up to about 99.9 wt% based on the total weight of the whitening strip.

11. The whitening strip of claim 1, wherein said water-soluble or water dispersible polymer system is about 60 wt% to about 95 wt% of the total weight of the whitening strip.

12. The whitening strip of claim 1, wherein said water-soluble or water dispersible polymer system is also hydratable on contact with saliva.

13. The whitening strip of claim 12, wherein the whitening strip adapts to the morphology of the teeth upon contact with saliva in the oral cavity.

14. The whitening strip of claim 1, wherein the whitening strip is free of surfactants.

15. The whitening strip of claim 1, further comprising:

an ingredient selected from the group consisting of an antimicrobial agent, a mineralization compound, a desensitization compound, an anti-calculus agent, a flavoring agent, an anti-inflammatory agent, an antioxidant, a stain prevention agent, and any combinations thereof.

16. The whitening strip of claim 15, wherein said antimicrobial is selected from the group consisting of triclosan, zinc salts, stannous fluoride, chlorhexidine, hexetidine, sanguinarine, benzalkonium chloride, salicylanilide, domiphen bromide, cetylpyridinium chloride, tetradecylpyridinium chloride, N-tetradecyl-4-ethylpyridinium chloride, octenidine, delmopinol, octapinol, nicin preparations, zinc/stannous ion agent, antibiotics and analogs and salts thereof, essential oils, and any combinations thereof.

17. The whitening strip of claim 15, wherein said mineralization compound is selected from the group consisting of sodium monofluorophosphate, potassium monofluorophosphate, amine fluoride, bis-salicylato-bis-fluorotitanium (IV), magnesium monofluorophosphate, acidulated fluorophosphate, sodium fluoride, potassium fluoride, calcium fluoride, stannous fluoride, sodium fluorosilicate, ammonium fluorosilicate, calcium salts, phosphate salts, and any combinations thereof.

18. The whitening strip of claim 15, wherein said desensitization compound is a water-soluble potassium salt selected from the group consisting of potassium nitrate, potassium citrate, potassium chloride, potassium bicarbonate, potassium oxalate, or a tubular occlusion agent and any combinations thereof.

19. The whitening strip of claim 15, wherein said anti-calculus agent is selected from the group consisting of a phosphate ester,

pyrophosphate, polyphosphate, phosphonate, polyphosphonate, polyacrylate, polycarboxylate, carboxylic acid, a salt of said carboxylic acid with sodium and/or zinc, ethylenediaminetetraacetic acid, and any combinations thereof.

20. The whitening strip of claim 1, further comprising a plasticizer.

21. The whitening strip of claim 19, wherein said phosphonate is selected from the group consisting of ethane-1-hydroxy-1,1-diphosphonate, 1-azacycloheptane-1,1-diphosphonate, any combinations thereof.

22. The whitening strip of claim 15, wherein said flavoring agent is selected from the group consisting of spearmint, peppermint, wintergreen, sassafras, clove, sage, eucalyptus, marjoram, cinnamon, lemon, menthol, anethole, thymol, parsley oil, oxanone, orange, alpha-irisone, cassia, marjoram, oils thereof, propenyl guaethol, methyl salicylate, sucrose, lactose, maltose, sorbitol, xylitol, sodium cyclamate, sodium saccharin, aspartame, sucralose, acesulfame K, and any combinations thereof.

23. The whitening strip of claim 15, wherein said anti-inflammatory agent is a non-steroidal anti-inflammatory agent selected from the group consisting of ketorolac, flurbiprofen, ibuprofen, naproxen, indomethacin, aspirin, ketoprofen, piroxicam, meclofenamic acid, and any combinations thereof.

24. The whitening strip of claim 15, wherein said antioxidant is a selected from the group consisting of Vitamin E, ascorbic acid, uric acid, a carotenoid, Vitamin A, kojic acid, a flavonoid, a phenolic compound, a polyphenol, a coenzyme, an herbal antioxidant, melatonin, an aminoindole, a lipoic acids, rosemary extract, tocopherol, tocotrien, a bioflavonoid, a plant extract, curcumin, tetrahydrocurcumin, camphorol, quercetin, epigallocatechin gallate, and any combinations thereof.

25. The whitening strip of claim 1, wherein the whitening strip is free of a backing.

26. The whitening strip of claim 1, wherein said strip is prepared by a method selected from the group consisting of solution deposition, film-casting, dye-casting and extrusion.

27. The whitening strip of claim 1, wherein the whitening strip is a single layer.

28. The whitening strip of claim 27, wherein the layer has a surface with two or more zones.

29. The whitening strip of claim 28, wherein each one of the two or more zones have different compositions.

30. A dissolvable, whitening strip for whitening teeth in an oral cavity, comprising:

a controlled-dissolution, water-soluble or water dispersible whitening film having a whitening agent and a water-soluble or water dispersible polymer system, said polymer system has a poly(vinylpyrrolidone) or any of its copolymers or its derivatives and at least one other polymer,

wherein the dissolution of the whitening strip is controlled by interaction of the whitening strip with saliva in the oral cavity.

31. The whitening strip of claim 30, wherein the whitening strip is a flexible thin film free of a backing.

32. The whitening strip of claim 31, wherein the whitening strip is a single layer.

33. The whitening strip of claim 30, wherein the whitening strip has a thickness of about 5  $\mu\text{m}$  to about 2000  $\mu\text{m}$ .

34. A dissolvable, multi-layer strip for whitening teeth in an oral environment, comprising:

a first controlled-dissolution film having a first whitening agent and a first water-soluble or water dispersible polymer system; and

a second controlled-dissolution film disposed on said first film and having a second whitening agent and a second water-soluble or water dispersible polymer system,

wherein said first and said second films are joined to form a stack, and

wherein the dissolution of each of said first and said second films is controlled by interaction of said first and second films with saliva in the oral environment.

35. The multi-layer strip of claim 34, wherein said first polymer system has poly(vinylpyrrolidone) or any of its copolymers or its derivatives.

36. The multi-layer strip of claim 35, wherein said first polymer system also has at least one other polymer.

37. The multi-layer strip of claim 35, wherein said second polymer system has a poly(vinylpyrrolidone) or any of its copolymers or derivatives.

38. The multi-layer strip of claim 37, wherein said second polymer system also has at least one other polymer.

39. The multi-layer strip of claim 34, wherein the first and second whitening agents are the same.

40. The multi-layer strip of claim 34, wherein said first film has a different whitening agent and/or water-soluble or water dispersible polymer system than said second film.

41. The multi-layer strip of claim 34, further comprising one or more layers of said first and/or said second films in single or repeating units.

42. The multi-layer strip of claim 41, wherein each of said one or more layers of said first and/or second films has a whitening accelerator to provide rapid decomposition of the bleach for enhanced whitening efficacy.

43. The multi-layer strip of claim 41, wherein each of said one or more layers of said first and/or said second films has a different structure or composition to provide different rates of dissolution.

44. The multi-layer strip of claim 43, wherein said structure or composition in each of said first and said second films is selected to provide a directional dissolution of the multi-layer strip.

45. The multi-layer strip of claim 34, further comprising a layer having a whitening agent on the surface of any layer.

46. The multi-layer strip of claim 45, wherein said whitening agent is encapsulated.

47. The multi-layer strip of claim 34, wherein said first film has two or more zones with each zone having a different composition.



48. The multi-layer strip of claim 47, wherein said second film has two or more zones with each zone having a different composition.

49. The multi-layer strip of claim 48, wherein the two or more zones of said first film and the two or more zones of said second film each have a different composition.

50. A process for preparing a whitening strip in the form of a dry film, comprising:

combining a whitening agent, a water-soluble or water dispersible polymer system for said whitening agent and a volatile solvent, to form a mixture;

applying said mixture onto a surface to form a film of said mixture on said surface; and

removing said volatile solvent to produce a whitening strip in the form of the dry film.

51. A method of whitening teeth, comprising:

applying onto the teeth whitening strips as a regimen specified in the direction for use according to claim 1 for a period of time sufficient to produce a detectable improvement in the whiteness of the teeth.

52. The method of whitening teeth according to claim 51, wherein said period of time is from about 1 minute to about 360 minutes.

53. The method of whitening teeth according to claim 51, wherein said period of time is from about 1 minutes to about 30 minutes.

54. The method of whitening teeth according to claim 51, wherein said period of time is from about 5 minutes to about 20 minutes.

55. A method of whitening teeth, comprising:  
applying onto the teeth a multi-layer whitening strip according to claim 31 for a period of time sufficient to produce a detectable improvement in the whiteness of the teeth.

56. The method of whitening teeth according to claim 55, wherein said period of time is from about 1 minute to about 360 minutes.

57. The method of whitening teeth according to claim 55, wherein said period of time is from about 1 minute to about 30 minutes.

58. The method of whitening teeth according to claim 55, wherein said period of time is from about 5 minute to about 20 minutes.